

## **UAV Science or Application Mission Implementation Plan** **Guidelines**

### **I. Introduction**

The Office of Earth Science received 11 very good proposals in response to the UAV NASA Research Announcement (NRA-99-OES-02). Based upon the evaluation of all proposals received, NASA has determined to proceed with the preparation of implementation plans to address the reduction of the risk associated with implementing UAV-based science missions. Final Selection of two or three missions will be based on revised proposals benefiting from this planning study.

The Implementation Study objectives are:

- Reduce risks associated with incomplete planning in proposal phase.
- Encourage PIs to consider implementation details so that their revised proposals comply with NRA submittal requirements.
- Provide a plan from which progress can be measured under any follow-on grant
- Add to NASA and community knowledge on Earth Science-based requirements for UAVs.
- Provide data for our initial Business Model for making UAV asset decisions

This Implementation Study is desired to address the following issues:

- Better identify and document user requirements
- Better understand the system concept and operations
- Promote sufficient system studies and analyses
- Promote realistic Schedule and Budget estimates
- Promote sufficient preparation for system operation

The Implementation Study is expected to be organized by Phases to provide decision points for transition to the next phase. For the purpose of these guidelines, project phases are defined as follows:

1. Pre-deployment (payload development, mission planning)
2. Deployment (mobilization, flight/mission operations, demobilization)
3. Post-deployment (analysis/reporting)

A mid-term progress briefing at NASA HQ will be requested. A Final Report is expected ninety days after award.

The desired uniform Implementation Study format and contents are summarized in the following sections. Study participants are strongly encouraged to follow this outline.

The Implementation Study Report should contain the following:

Introduction

Technical Plan

- Mission Requirements
- Mission Concept

- Payload Integration Plan
- Deployment Plan
- Flight Plan
- Non-NASA A/C Safety Plan
- Airspace Management Plan
- Data Analysis & Archival Plan

#### Management Plan

- Roles and Responsibilities
- Work Breakdown Structure
- Project Control Plan
- Project Risk Assessment and Management Plan
- Liability Assessment and Management Plan

Other supporting information as separate document(s)

- Cost Estimating Methodology
- Business data

Mark proprietary information with appropriate restrictions

## **II. Section descriptions**

### **Technical Plan**

- Mission Requirements

In this section, discuss what are the mission requirements, and how they will be met.

Describe

- the problem to be solved, and in what context
- the concept of operation (functional flow)
- the baseline system
- the performance expectations
- quality assurance approach
- the constraints
- the level of risk acceptable
- how you will know the mission meets the requirements

- Mission Concept

In this section, discuss the Mission Concept anticipated to best meet Mission Requirements.

Highlight process of selecting mission concept, alternatives considered, impacts on scope, schedule and budget

- Payload Integration Plan

In this section, discuss the approach to Payload Integration.

Describe:

- Payload mass, volume, power, environmental control requirements and margins
- Issues and Concerns of the UAV service provider and the instrument teams
- Instrument modifications, and impact on payload integration planning
- Onboard communications

- Interface Control Document development
- Payload certification and test flights
- Schedule
- Roles and Responsibilities of the various participants

- Deployment Plan

In this section, discuss the Deployment Plan anticipated to best meet the mission requirements.

Describe:

- Deployment concept relative to mission requirements
- Facility needs (hanger, labs, range, communications, networks, security, etc.)
- Expendables (POL, cryogenics, etc.)
- Scope of required deployment
- Deployment Readiness Review
- Schedule
- Roles and Responsibilities of the various participants

- Flight Plan

In this section discuss the flight requirements relative to mission requirements. Describe:

- Mission flight concept(s)
- Mission flight location, profile, frequency and relevant performance characteristics
- Flight planning criteria
- Go-No Go criteria
- Roles and Responsibilities of the various participants

- Non-NASA A/C Safety Plan

Compliance with NASA safety and mission assurance requirements is the responsibility of the Principle Investigator. For the UAV Science Demonstration Program, the Non-NASA Aircraft Safety Policy applies. A copy is included as Attachment 1 of this guide. Please discuss how you propose to meet this requirement. State who will be responsible for this activity.

Describe your approach to providing a sufficiently detailed safety and mission assurance analysis of the proposed flight mission. The analysis should evaluate:

- the flight parameters of the program
- the airworthiness of the aircraft
- the capability of the aircraft to meet the flight requirements
- the background and experience of the operators
- the value or uniqueness of the payload
- the demands placed on the UAV service provider, which might expose them to risks beyond their capability to manage.

Describe your approach to answering the question; “Is this vehicle safe to fly this mission?” See <http://jcs.mil/RCC/manuals/323/index.html>

- Are the system hazards recognized, and risk controls available?
- How is this mission vulnerable to these identified system hazards?
- If safeguards are needed to reduce risk, will they work?

- **Airspace Management Plan**

Discuss the selection of flight range and the type of arrangements or agreement made with the flight range. Present a plan for obtaining approval to fly at the proposed range and/or in the national air space (NAS), if this is required for the proposed mission. Obtaining permission to fly represents a significant milestone in this program, as it is the key to deployment. Discuss in detail your understanding of this requirement, who will be responsible for this activity and the planned approach and schedule. Discuss any export control or international air space issues, if flights in international locations or air space are proposed.

- **Data Analysis & Archival Plan**

In this section, discuss the Data Analysis & Archival Plan anticipated to best meet the mission requirements. Describe:

- Analysis concept relative to mission requirements
- Quality Assurance approach
- Facility needs (hanger, labs, range, communications, networks, security, etc.)
- Data protocol and Archival plan
- Roles and Responsibilities of the various participants

## **Management Plan**

This section is intended to provide detail as to the management approach the PI will take to manage the effort and control the schedule and budget of the project; to clarify the roles and responsibilities of all team members; and to describe the entire project in terms of a Schedule and Work Breakdown Structure. A system engineering approach is anticipated.

Set forth in this section your approach for managing the work, identifying the essential management functions and the overall integration of these functions. Specifically discuss the decision-making process that the team will use, focusing particularly on the role of the Principal Investigator in that process. Provide insight through your management plan into the organizations identified for the work, including the internal operations and lines of authority with delegations, together with internal interfaces and relationships with NASA, major subcontractors, and associated investigators. Identify the institutional commitment of all team members and the institutional roles and responsibilities

Also describe in this section the management processes and plans that you need for the logical and timely pursuit of the work, and accompany this with a description of the work plan. Describe in this section your management plans for the following:

- **Pre-deployment Activities:**
  - Payload instrument development or acquisition, any modifications, integration and check-out; design for remote or autonomous operation
  - UAV / payload integration and test flights
  - Data analysis software development
  - Actions to meet FAA, range or NASA safety considerations
- **Deployment Activities**

- Mobilization/Demobilization
- Facility operations
- Mission control
- Flight operations
- Post-deployment Activities
  - Data archiving and distribution
  - Data analysis and scientific reporting

Discuss your planned management processes, including the relationship between organizations and key personnel, including the following, as applicable: systems engineering and integration; requirements development; configuration management; schedule management; team member coordination and communication; progress reporting, both internal and to NASA; performance measurement; and resource management. Include in this discussion all phases of the project including pre-deployment, deployment and post-deployment activities, as described previously.

#### Schedule

Clearly define the schedule and workflow for the complete project and discuss the method and tools you will use for internal review, control, and direction. Clearly identify the schedules for all major activities (including internal and required external reviews), interdependencies between major items, deliveries of end items, critical paths, schedule margins, and long-lead procurement items or activities.

Present a milestone schedule that includes estimated dates for the following programmatic events, along with other key technical milestones:

- Kick-off
- Critical Design Review
- NASA Safety Review
- Flight Readiness Review
- Deployment Readiness Review
- Mission Flights
- Science Report Delivery

#### • Roles and Responsibilities

Describe in this section the roles, responsibilities, time commitment, and experience of all team member organizations and key personnel, placing particular emphasis on the responsibilities assigned to the Principal Investigator (PI), Co-Investigators (Co-Is), and other key personnel.

**Name the person who will serve as Operations Interface for the entire project.** This person will interface between the science team and the flight organization. In addition, indicate by phase what percentage of time key personnel will devote to the project, the duration of service, and how you will accommodate changes in personnel.

Describe the management organizational structure of the investigation team. **Provide an organization chart showing the roles and relationships of team members.** Include the responsibilities of each team member and organization and their contributions to the

investigation. Describe each key position, including its roles and responsibilities, how each key position fits into the organization, and the basic qualifications required for each position. Describe the experience of the PI, Co-Is, and other team members. Include a discussion of the unique or proprietary capabilities that each member organization brings to the team, along with a description of the availability of personnel at each partner organization to meet staffing needs.

Discuss the contractual and financial relationships between all team partners, including especially the contractual relationship between the PI institution and the UAV provider, and between the PI institution or UAV provider and the flight range.

- **Work Breakdown Structure**

Include a Work Breakdown Structure for the three phases of the project, showing project elements to the major task level (e.g., engineering, integration, test, etc.) Describe the WBS to the subsystem level, including payload, UAV, communications, data management and archival systems, range operations, etc. A single all-encompassing WBS may be used for all phases, if desired, if there are elements that are not applicable to a specific phase. Show how the WBS is consistent with the proposed project schedule.

Provide a workforce-staffing plan that is consistent with the WBS. Include in this workforce-staffing plan all team member organizations, including NASA Civil Service and support contractors, and cover all management, technical and support staff. Show the time commitments for the PI and other key personnel by phase.

- **Project Control Plan**

Describe the Project Administration (Control) approach to managing the project. This includes integration of:

- Plans and requirements
- Resource and schedule management
- Contract management
- Configuration Management
- Data and information management
- Project Assessment

The PI is strongly encouraged to make use of a project control tool. Such systems offer innovative, effective and low-cost approaches for project control utilizing Distributed Planning Processes.

- **Project Risk Assessment and Management Plan**

For this study, risk is categorized in the following areas: scope, schedule and budget. Describe in this section the approach to and plans for risk management that the team will take with respect to these three areas for each phase of the project. Place particular emphasis on describing how you will manage or mitigate various elements of risk to ensure successful accomplishment of the mission within cost and schedule constraints.

Within the area of scope, discuss all of the following technical issues and any other areas of technical risk that apply to the proposed mission:

- payload power and power margin,
- payload mass and mass margin,
- payload volumetric requirements relative to UAV capabilities,
- UAV altitude and time at altitude capabilities,
- UAV availability,
- UAV turnaround time,
- UAV weather capabilities,
- UAV range constraints.

If UAV performance risk is managed by possible mission descope, describe the descope plan and discuss the impact of descope on science/application outcomes.

Discuss all risks that your team rate as “medium” or higher and your mitigation plans.

Discuss your methodology for establishing margins and reserves in cost and schedule. Discuss the rationale for the margins and reserves. Discuss the management of the reserves and margins. Discuss the impact of potential changes in scope on schedule and budget.

• **Liability Assessment and Management Plan**

Describe Platform, Payload and Third-party liability concerns. State how liability coverage will be provided for the UAV platform, payload and third party. Discuss the amount and scope of coverage of liability insurance. Discuss how this assessment was made.

**Other supporting information as separate document(s)**

• **Cost Estimating Methodology**

One major objective of this implementation study is to investigate more thoroughly the reasonableness, completeness, and consistency of the cost estimate for the proposed budget. Present the Basis of Estimate for each of the following cost elements. Discuss in sufficient detail to provide credibility to the estimate.

- Direct Labor
- Direct Material
- UAV Provider (Include a list of what is provided, e.g., platform, ground station, payload integration, communications link, flight operations, etc.)
- Range Provider
- Mission-related expenses (e.g., shipping, on-site equipment or facilities)
- Basic and real-time telecommunications services
- Other Subcontracts
- Other Direct Costs (including travel, computers, consultants, other)
- Liability Coverage
- Facilities and Administrative
- Management and Reviews
- Other Indirect Costs

- Outreach activities
- Reserves

- Business data

As stated in the Introduction, one objective of the Implementation Plan study is to provide NASA with data for a Business Model that will allow NASA to make UAV asset decisions in the future. A major decision may be whether NASA should operate UAVs in PI-mode, i.e., where the PI obtains UAV service from a vendor (as in this NRA), or whether NASA should acquire and operate UAVs as part of its airborne science fleet. To this end, the following information regarding business relationships and specific cost issues will be very useful. In this section of the report provide all the information requested below, even if it has been discussed previously in the report.

Issues related to business relationships and responsibilities:

- Describe the proposed contractual relationship between PI and NASA.
- Describe the proposed contractual relationship between PI and the UAV provider, e.g., subcontract, lease, etc.
- Provide a comprehensive discussion of how the mission responsibilities are divided between the PI and the UAV vendor.
- State which party will be liable/responsible for the UAV.
- State which party will be liable/responsible for the payload.
- Describe how financial responsibility will be managed among the participating organizations.
- State who will oversee the schedule and budget on a day-to-day basis.
- Describe the agreement with the proposed flight range or facility. What contractual relationship is proposed?
- State who will undertake activities required to obtain permission to fly, including safety review and air space management.
- State who will be responsible for payload integration into the UAV.

Issues related to mission costs:

- Discuss what portions of the planned schedule and budget are devoted to each of the following activities: payload development, integration, testing, required reviews, site / facilities preparation, science flights, data analysis and documentation, and outreach.
- Discuss the level of uncertainty in the budget and how it was determined. Discuss budget contingencies and reserves.
- Specifically discuss any budget negotiations and uncertainties with the range or flight facility.
- Describe how will the budget be tracked and reported (methodology).
- Discuss the uncertainty in the schedule and the budget impact of schedule uncertainty.
- Describe UAV flight costs, i.e., \$/hr, \$/flight, \$/operation. List all components of the flight cost. Discuss other UAV vendor expenses not included in the flight cost.
- Discuss the availability and maturity of the planned payload / instruments. Will the instruments be purchased or leased? Discuss costs of modification for remote or autonomous operation. Discuss costs related to integration into the UAV.
- Describe costs for mission-related operations, such as shipping, site facilities, and on-site communications.

- Discuss plans and costs for ground control of the platform and payload.
- Describe data management plans for science data and costing methodology for data acquisition, archiving, analysis, and distribution.

Mark proprietary information with appropriate restrictions

### **III. Page Limits**

The Implementation Plan should be limited to 50 pages. Optional appendices, not included in the page count, may include Cost Estimating Methodology, Business Data, resumes, references, and a list of acronyms and other information of merit at the discretion of the PI.